



Amendment ~~1~~ 2 / C.F.R. § 1.111
U.S. Application No. 10/644,934

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

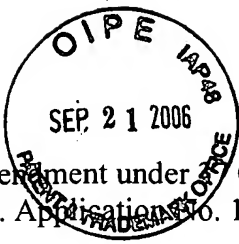
1. (currently amended) A data copying system comprising:

a first storage unit;

a second storage unit, data stored in said first storage unit being copied by mirroring or backup to said second storage unit over a communication network; and

a relaying device for relaying data transferred from said first storage unit to said second data storage unit over the communication network, said relaying device being provided in a location that is pre-calculated and different from a location of said first and second storage units, so that, even if said first storage device cannot be operated due to a disaster, the operation of said relaying device can be continued;

wherein said first storage unit includes data transfer processing means for controlling data transfer, said data transfer processing means regarding the data transfer from said first storage unit to said second storage unit as being completed when data transfer from said first storage unit to said relaying device is completed.
2. (original) The data copying system according to claim 1, wherein said relaying device includes:



Amendment under 37 C.F.R. § 1.111
U.S. Application No. 10/644,934

non-volatile storage means for storing a command and data received from the first storage unit; and

relaying processing means for relay controlling the data, said relaying processing means causing the command and the data received from said first storage unit to be stored in said non-volatile storage means and transmitting the command and data stored in said non-volatile storage means to said second storage unit at an optional timing.

3. (original) The data copying system according to claim 1, further comprising a plurality of said relaying devices, wherein said data transfer processing means in said first storage unit simultaneously sends data stored in said first storage unit to a plurality of said relaying devices.

4. (currently amended) A relaying device for relaying data transferred from a first storage unit to a second storage unit, said relaying device comprising:

storage means for storing data received from said first storage unit; and

relaying processing means for relay controlling data;

wherein said relaying processing means causes data received from said first storage unit to be stored in said storage means; and

wherein, when the data is stored in said storage means, said relaying processing means sends a response to said first storage unit and sends the data stored in said storage means to said second storage unit, and

wherein said relaying device is provided in a location that is pre-calculated and different from a location of said first and second storage units, so that, even if said first storage device cannot be operated due to a disaster, the operation of said relaying device can be continued.

5. (original) A transmitting/receiving method, in which data transmitted from a source unit is received by a destination unit, said method comprising the steps of:

said source unit creating at least one redundant data for error correction from original data to be transmitted; and

said source unit transmitting the original data and the redundant data in separate data transmission units.

6. (original) The data transmitting/receiving method according to claim 5, further comprising the step of:

said destination unit executing error correction processing before completion of reception of an entire assemblage of data comprised of a set of the original data and the redundant data, at a stage when a portion of said data set enabling partial error correction of said original data is received.

7. (original) The data transmitting/receiving method according to claim 5, further comprising the step of:

said source unit dividing the original data into divided data and creating redundant data which enables restoration of the original data even on occurrence of loss of one or more of said divided data.

8. (original) The data transmitting/receiving method according to claim 5, wherein parity data or ECC(Error Correction Code) is used as said redundant data.

9. (original) The data transmitting/receiving according to claim 5, wherein copied data of transmission data is used as said redundant data.

10. (original) The data transmitting/receiving method according to claim 5, wherein the original data and the redundant data are sent over separate communication networks.

11. (original) A data copying system comprising:

a first storage unit; and

a second storage unit, data stored in said first storage unit being copied by mirroring or backup to said second storage unit over a communication network;

wherein said first storage unit includes:

data transfer processing means for controlling data transfer; and

redundancy processing means for creating at least one redundant data for error correction from the original data to be transmitted;

said data transfer processing means transmitting the original data and the redundant data created by said redundancy processing means in separate data transfer units.

12. (original)The data copying system according to claim 11, wherein said second storage unit includes:

data restoration means for executing error correction processing using the redundant data received from said first storage unit; and

storage processing means for storing the data restored by said data restoration means on a recording medium;

wherein said data restoration means executes error correction processing before completion of reception of an entire assemblage of data comprised of a set of the original data and the redundant data, at a stage when a portion of said data set enabling partial error correction of said original data is received.

13. (original) The data copying system according to claim 11, wherein said redundancy processing means in said first storage unit divides said original data into divided data and creates redundant data which enables restoration of the original data even on occurrence of loss of one or more of said divided data.

14. (original)The data copying system according to claim 11, wherein said redundancy processing means uses parity data or ECC (Error Correction Code) as said redundant data.

15. (original) The data copying system according to claim 11, wherein said redundancy processing means uses copied data of transmission data as said redundant data.

16. (original) The data copying system according to claim 11, wherein said data transfer processing means sends the original data and the redundant data over separate communication network.

17. (original) A data copying system comprising:

a storage unit of an operation system; and

a storage unit of a standby system; data stored in said storage unit of the operation system being copied to said storage unit of the standby system over a communication network by mirroring,

wherein said storage unit of the operation system includes:

delay write requesting means for sending data as a target of writing and a delay write request to said storage unit of the standby system on occurrence of a data write request; and

write execution requesting means for sending a delay write execution request to said storage unit of the standby system on receipt from a higher rank device of a restart enabling point notification asserting a restart enabling point for which an application may directly restart operation for prevailing data state; and

wherein said storage unit of the standby system includes:

temporary storage means for temporarily storing data; and

storage processing means for storing received data in said temporary storage means responsive to the delay write request received and for storing the data stored in said temporary storage means in said recording medium on receipt of said delay write execution request.

18. (original) The data copying system according to claim 17, wherein

the delay write requesting means and the delay write execution requesting means in said storage unit of the operation system asynchronously send a delay write request and a delayed write execution request to said storage unit of the standby system; and

wherein said storage processing means in said storage unit of the standby system on receipt of one delay write execution request causes data stored in said temporary storage means to be stored in the recording medium when data associated with the delay write request transmitted between a delay write execution request directly previous to said one delay write execution request and said one delay write execution request have all been stored in said temporary storage means and when the data transmitted before said directly previous delay write execution request have been stored in said recording medium.

19. (original) The data copying system according to claim 17, wherein, when an abnormality occurs in the operation system, said storage processing means in said storage unit of the standby system discards data stored in said temporary storage means.

20. (currently amended) A data copying system comprising:

a storage unit of an operation system; and

a storage unit of ~~an operation~~ a standby system; data in said storage unit of the operation system being copied by mirroring to said storage unit of the standby system over a communication network;

wherein said storage unit of the ~~standby~~ operation system includes:

write requesting means which, on occurrence of a data write request, sends data to be written and a write request to said storage unit of the standby system; and

snap shot formation requesting means for sending a snap shot forming request to said storage unit of the standby system on receipt from a higher rank device of a restart enabling point notification asserting a restart enabling point for which an application may directly restart operation for prevailing data state; and

wherein said storage unit of the standby system includes:

snap shot forming means which, on receipt of a write request, allocates an area for writing data corresponding to said write request to store the data in said recording medium and to update the storage information indicating the state of data storage in said recording medium, and which on receipt of the snap shot forming request forms a snap shot,

wherein, when the snap shot forming means in said storage unit of the standby system forms a snap shot, said write requesting means sends a write request to said storage unit of the standby system after said snap shot forming means completes forming the snap shot.

Claim 21 (canceled).

22. (original) The data copying system according to claim 20, wherein said write requesting means and the snap shot formation requesting means in the storage unit of the operation system asynchronously send the write request and the snap shot forming request to the storage unit of the standby system;

said snap shot forming means in said storage unit of the standby system on receipt of each write request awaits storage of data corresponding to the write request in the recording medium until the snap shot based on the snap shot forming request directly before the received write request is formed completely;

said snap shot forming means on receipt of one snap shot forming request forming a snap shot when a snap shot based on the directly previous snap shot forming request is completed and all data corresponding to the write request transmitted between said directly previous snap shot forming request and said one snap shot forming request have all been stored in the recording medium.

23. (original) The data copy system according to claim 20, wherein, when an abnormality occurs in an operation system, said snap shot forming means in the storage unit of the standby system releases the area of the recording medium, where data has been stored after forming the directly previous snap shot, to a non-use state, to restore the stored information to the state at the time of forming the directly previous snap shot.

24. (original) The data copying system according to claim 23, wherein

a higher rank device of the operation system employing the storage unit of the operation system includes restart enabling point notification means for sending a restart enabling point notification to said storage unit of the normal system when timing is a restart enabling point; and

wherein

a higher rank device of the standby system employing the storage unit of the standby system on detection of an abnormality of said operation system notifies the storage unit of the standby system of the occurrence of an abnormality to prompt restoration of the status of the storage unit of the standby system to a state corresponding to said restart enabling point to restart the processing when the state of the storage unit of the standby system is the state corresponding to the restart enabling point.

25. (original) The data copying system according to claim 23, wherein

a higher rank device of the operation system employing the storage unit of the operation system includes:

execution image transfer means for transferring an execution image indicating the processing executing state of the operation system to a higher rank device of the standby system employing the storage unit of the standby system; and

optional time point restart enabling point notification means for sending a restart enabling point notification at a timing of the execution image transmitting means transmitting an execution means;

wherein

a higher rank device of the standby system employing said storage unit of the standby system includes execution image saving means for saving an execution image transferred by said execution image transfer means, said execution image transfer means transferring an execution image at an optional time point to said higher rank device of the standby system; and

wherein

said higher rank device of the standby system employing said storage unit of the standby system on detection of an abnormality of said operation system notifies the storage unit of the standby system of the occurrence of the abnormality to prompt restoration of the status of the storage unit of the standby system to a state corresponding to said restart enabling point, so as to restart the processing, using an execution image, when the state of said storage unit of the standby system is the state corresponding to the restart enabling point.

26. (original) The data copying system according to claim 25, wherein the execution image transferring means in said higher rank device of the operation system transfers only the portion changed from the execution image transferred last time.

27. (currently amended) A computer program product comprising a computer usable medium having computer readable program code therein, said program code causing a computer provided in a relaying device in a data copying system, in which data in a first storage unit is copied by mirroring or backup to a second storage unit via a communication network and the relaying device to execute the steps of:

causing storage of data received from said first storage unit in a recording medium in the relaying device;

sending a response to said first storage unit on storage of data in said recording medium in said relaying device; and

sending the data stored in the recording medium in the relaying device to said second storage unit,

wherein said relaying device is provided in a location that is pre-calculated and different from a location of said first and second storage units, so that, even if said first storage device cannot be operated due to a disaster, the operation of said relaying device can be continued.

28. (original) A computer program product comprising a computer usable medium having computer readable program code therein, said program code causing a computer provided in a first storage unit in a data copying system, in which data in the first storage unit is copied by mirroring or backup to a second storage unit via a communication network to execute the steps of:

forming at least one redundant data for error correction from transmitted original data; and

transmitting the original data and the redundant data by separate data transfer units.

29. (currently amended) A computer program product comprising a computer usable medium having computer readable program code therein, said program code causing a computer provided in an operation storage unit in a data copying system, in which data in the operation storage unit is copied by mirroring to a standby storage unit via a communication network to execute the steps of:

sending data to be written and a delay write request instructing storage of the data in a temporary storage device to said storage unit of the standby system, on occurrence of a data write request;

sending to said storage unit of the standby system a delay write execution request instructing storage in the recording medium of data stored in the temporary storage device on

receipt from a higher rank device of a restart enabling point notification asserting a restart enabling point for which an application may directly restart operation for prevailing data state,

wherein said temporary storage device is provided in a location that is pre-calculated and different from a location of said operation storage unit and said standby storage unit, so that, even if said operation storage device cannot be operated due to a disaster, the operation of said temporary storage device can be continued.

30. (original) A computer program product comprising a computer usable medium having computer readable program code therein, said program code causing a computer provided in an operation storage unit in a data copying system, in which data in the operation storage unit is copied by mirroring to a standby storage unit via a communication network to execute the steps of:

sending data to be written and a write request instructing writing the data in a recording medium, to said storage unit of the standby system, on occurrence of a data write request; and

sending to said storage unit of the standby system a snap shot forming request on receipt from a higher rank device of a restart enabling point notification asserting a restart enabling point for which an application may directly restart operation for prevailing data state.

31. (original) The data copying system according to claim 2, further comprising a plurality of said relaying devices, wherein said data transfer processing means in said first

storage unit simultaneously sends data stored in said first storage unit to a plurality of said relaying devices.

32. (original) The data copying system according to claim 19, wherein

a higher rank device of the operation system employing the storage unit of the operation system includes restart enabling point notification means for sending a restart enabling point notification to said storage unit of the normal system when timing is a restart enabling point; and wherein

a higher rank device of the standby system employing the storage unit of the standby system on detection of an abnormality of said operation system notifies the storage unit of the standby system of the occurrence of an abnormality to prompt restoration of the status of the storage unit of the standby system to a state corresponding to said restart enabling point to restart the processing when the state of the storage unit of the standby system is the state corresponding to the restart enabling point.

33. (original) The data copying system according to claim 19, wherein

a higher rank device of the operation system employing the storage unit of the operation system includes:

execution image transfer means for transferring an execution image indicating the processing executing state of the operation system to a higher rank device of the standby system employing the storage unit of the standby system; and

optional time point restart enabling point notification means for sending a restart enabling point notification at a timing of the execution image transmitting means transmitting an execution means;

wherein

said higher rank device of the standby system employing said storage unit of the standby system includes execution image saving means for saving an execution image transferred by said execution image transfer means, said execution image transfer means transferring an execution image at an optional time point to said higher rank device of the standby system; and

wherein

said higher rank device of the standby system employing said storage unit of the standby system on detection of an abnormality of said operation system notifies the storage unit of the standby system of the occurrence of the abnormality to prompt restoration of the status of the storage unit of the standby system to a state corresponding to said restart enabling point, so as to restart the processing, using an execution image, when the state of said storage unit of the standby system is the state corresponding to the restart enabling point

34. (original) The data copying system according to claim 32, wherein the execution image transferring means in said higher rank device of the operation system transfers only the portion changed from the execution image transferred last time.